Chapter 9
Orthophotographs and Orthophoto Maps

9-1. General

Orthophotographs can be used as a substitute for a topographic line map for certain smaller scale, nondesign applications, such as LIS. If terrain relief is slight, simple rectification of an aerial photograph is sufficient. In areas of medium to high relief, an orthophoto must be made by means of differential rectification. Orthophotos should not be specified when removal of relief distortion is not critical to the functional application, as is the case in most GIS data elements or USACE river and harbor navigation maps. Orthophotos are of no value when digital CADD planimetric data files are required. Including orthophotos with conventional planimetric line maps is a waste of resources—simple (and more economical) semicontrolled, rectified air photo plans should be used instead. An orthophoto should not be considered as a substitute for a detailed line map since feature details are not as accurate or discernable on an orthophotograph as in a stereoplotter.

9-2. Methods of Rectification

Orthophotographs may be prepared by either simple rectification or differential rectification, depending on the relief difference in each aerial photograph. Simple rectification is adequate for photographs containing no more relief in feet than the scale in feet to the inch multiplied by the factor 0.03. This assures that the displacement due to relief of any photographic image will not exceed the specification limit for planimetry. For example, differential rectification is required for any photograph at a scale of 200 ft to the inch in an orthophoto map project made from photographs taken with a 6-in. focal length camera lens if the relief in that photograph exceeds 6 ft.

9-3. Orthophoto Quality

The final orthophoto is a true map portraying planimetric information by photographic imagery. The orthophoto should be free of visible scan lines and mismatched imagery, as well as dust, scratch marks, and inconsistencies in tone and density between individual orthophotos.

9-4. Contours

Contours can be added to (or superimposed onto) the orthophotographs through the plotting system provided in the analytical orthoplotters or by resetting the original stereomodels and compiling the contours onto a transparent overlay registered to the orthophotographs. The contours may be photographically combined into the orthophoto map, and may be shown as either white or black lines. The selection is made to effect the greatest contrast, considering the predominant tone of the work area. Cartographic symbolization, contour numbers, spot elevations, and border and title information can be compiled and reproduced in the photo laboratory.

9-5. Enlargement Factor

In making orthophoto maps, the enlargement from the aerial photo scale to the final orthophoto map is critical. The enlargement will not exceed 4 to 8 times as shown in Table 9-1.

9-6. Position Accuracy

In order to meet position accuracy requirements, special considerations may be necessary at locations where the ground elevation changes abruptly, as at vertical cliffs, retaining walls, and bridges. If the equipment used cannot accommodate such a sudden vertical change, it will be necessary to prepare two orthophotographs of such areas, one that depicts faithfully the upper level of the terrain and another that depicts faithfully the lower level of the terrain. The two shall then be combined by special photographic printing techniques or by removing a portion from one orthophotograph and inserting it into the other. The resulting montage shall meet all dimensional and aesthetic specifications. No attempt shall be made to place the tops of buildings, tanks, towers, trees, etc., in map position; rectification shall be at a ground level.

9-7. Orthophotograph Preparation Guidelines

Table 9-1 presents guidelines for the preparation of orthophotos.

9-8. Deliverables

All materials including the orthophotograph negatives, the control prints, and the diapositives will be furnished

Table 9-1
Orthophotograph Preparation Guidelines

Description	Orthophotograph		
USACE Map Accuracy Class	1	2	3
Maximum Enlargement Factor from Negative	4 times	6 times	8 times
Ground Control Required	Yes	Yes	Yes
Mismatch of Features Across Join Lines	Not to Exceed 1/50 in.	Not to Exceed 1/40 in.	Not to Exceed 1/20 in.
USACE Map Accuracy Class Vertical Information	Contours generated from digital file required to rectify photographs	N/A	N/A
Recommended Minimum Equipment	Wild OR-1, Gigas-Zeiss, or equivalent	Wild OR-1, Gigas-Zeiss, or equivalent	K320 Orthoscan, or T-64 Ortho-photoscope or equivalent

to the Contracting Officer as stipulated in the contract specifications.

9-9. Equipment

The orthophotograph shall be compiled on an instrument capable of making direct enlargements up to eight diameters between original negative scale and compilation scale.